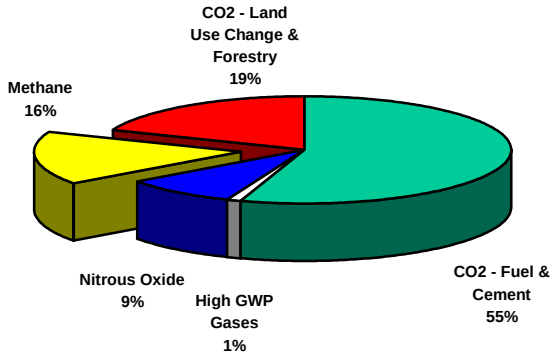
THE SIGNIFICANCE OF METHANE AND U.S. ACTIVITIES TO REDUCE METHANE EMISSIONS

Methane is a hydrocarbon that is the primary component of natural gas. Methane (CH_4) is also a "greenhouse gas," meaning that its presence in the atmosphere affects the earth's temperature and climate system. As a result, efforts to reduce methane emissions can yield environmental, economic, and energy benefits. This fact sheet provides basic background on methane and its role in climate change, discusses some of the currently available emission reduction opportunities, and provides a brief summary of U.S. efforts to voluntarily reduce emissions.

METHANE AS A GREENHOUSE GAS

Methane is second only to carbon dioxide (CO_2) as a greenhouse gas resulting from human activities. Methane is a short-lived greenhouse gas (GHG) with an atmospheric lifetime of approximately 12 years. Methane is also considered a potent GHG because, on a kilogram for kilogram basis, methane is 23 times more effective at trapping heat in the atmosphere than CO_2 over a 100-year time period.

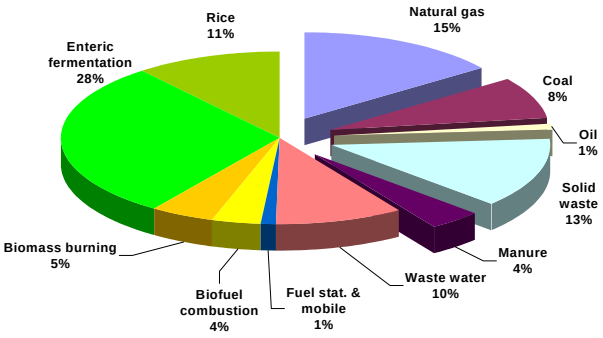
Figure 1. Global GHG Emissions - 2000



Over the last two centuries, methane concentrations in the atmosphere have more than doubled. Atmospheric concentrations are determined by the balance of the input rate and the removal rate. Input rates have increased due to human activity. Removal rates are determined by the effectiveness of "sinks" (systems that absorb or neutralize a greenhouse gas). The primary methane sinks are oxidation by chemical reaction with tropospheric hydroxyl (OH), stratospheric oxidation, and microbial uptake by soils. The strength and effectiveness of these sinks determine methane's atmospheric lifetime.

Methane accounts for approximately 16 percent of global GHG emissions (see Figure 1). Methane is emitted from a variety of both anthropogenic (human-influenced) and natural sources. Anthropogenic emission sources include coal mining, natural gas and oil systems, landfills and agriculture. About 60% of global methane emissions come from these sources and the rest are from natural sources (principally wetlands, gas hydrates and permafrost, and termites). (See Figure 2)

Figure 2. Global Anthropogenic Methane Emissions by Source



Globally, China, India, the United States, Brazil, and Russia and other Eurasian countries are responsible for almost half of all anthropogenic methane emissions. Methane emission sources, however, can vary significantly between countries. For example, the two key sources of methane emissions in China are coal mining and rice production, whereas Russia emits most of its methane from natural gas and oil systems. India's primary sources are rice and livestock production, whereas landfills are the largest source of U.S. methane emissions.

METHANE REDUCTION BENEFITS

Reducing methane emissions has many important energy, safety, economic, and environmental benefits. First, because methane is both a potent GHG and has a short atmospheric lifetime, methane reductions can produce significant near-term results. In addition, methane is the primary constituent of natural gas. Thus, the collection and utilization of methane provides a valuable, clean-burning energy source that improves quality of life in local communities and can generate revenue and improve living standards. Producing energy from recovered methane can

also avoid the use of higher-emitting energy resources such as wood, coal or oil. This can reduce end user and power plant emissions of CO_2 and air pollutants such as sulfur dioxide (which is a major contributor to acid rain), particulate matter (a respiratory health concern), and trace hazardous air pollutants. Capturing methane from coal mines can also improve safety conditions by reducing explosion hazards.

METHANE REDUCTION OPPORTUNITIES

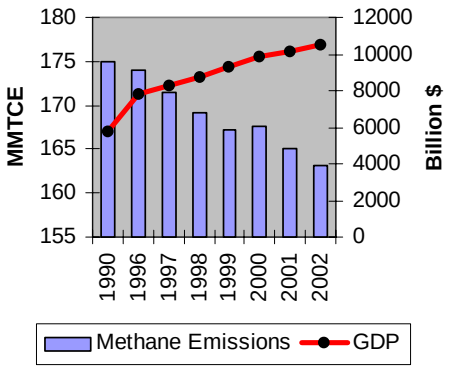
Three 30 kW microturbines running on landfill gas in California (USA).

Many of the available methane emission reduction opportunities involve the recovery and use of the methane as fuel for electricity generation, on-site uses, or off-site gas sales. These actions represent key opportunities for reducing emissions from landfills, coal mines, natural gas and oil systems, and livestock manure management. Specific technologies and mitigation approaches, however, vary by emission source due to their different characteristics and emission processes. Below are some of the methane recovery and use options for some of the key emission sources.

- **Coal Mines -** Methane is removed from underground mines either in advance of mining, during mining activities, or after mining has occurred to reduce explosion hazards. Instead of releasing this methane to the atmosphere, profitable uses can be identified and implemented. Some of these options include natural gas pipeline injection, power production, co-firing in boilers, district heating, coal drying, and vehicle fuel.
- **Landfills** - The principal approach to reduce methane emissions from landfills involves the collection and combustion or use of landfill gas (LFG). Landfill gas utilization technologies focus on electricity generation and direct gas use. Electricity generation involves piping collected methane to reciprocating engines or combustion turbines where it can be converted to electricity. Direct use technologies may use landfill gas directly as a medium-Btu fuel, while others require the gas to be upgraded and distributed to a natural gas pipeline.
- **Natural Gas and Oil Systems** - Current opportunities for reducing methane emissions include both procedural and hardware improvements. Methane emission reduction opportunities generally fall into one of three categories: (1) technologies or equipment upgrades that reduce or eliminate equipment venting or fugitive emissions; (2) improvements in management practices and operational procedures; or (3) enhanced management practices that take advantage of improved technology. In all cases, reducing methane emissions makes additional gas available for sale and use.

U.S. EFFORTS TO REDUCE METHANE EMISSIONS

Figure 3. Changes in US Methane Emissions and Economic Growth 1990 - 2002



Since 1993, the U.S. Environmental Protection Agency (EPA) has been collaborating with U.S. industries and state and local governments to implement several voluntary programs that promote cost-effective opportunities for reducing emissions of methane. These programs include the Natural Gas STAR Program, Landfill Methane Outreach Program, the Coalbed Methane Outreach Program and the AgSTAR Program. Each program is designed to overcome a wide range of informational, technical, and institutional barriers to reducing methane emissions, while creating cost-effective activities for the coal, natural gas, petroleum, landfill, and agricultural industries.

The collective results of EPA's voluntary methane partnership programs have been substantial. As Figure 3 illustrates, total U.S. methane emissions in 2001 were more than 5% lower than emissions in 1990, in spite of significant economic growth over that time period. EPA expects that these programs will maintain emissions below 1990 levels in the future due to expanded industry participation and the continuing commitment of the participating companies to identify and implement cost-effective technologies and practices.

FOR MORE INFORMATION ON METHANE, REDUCTION OPPORTUNITIES, AND EPA'S VOLUNTARY PROGRAMS, PLEASE VISIT EPA'S WEB SITE AT WWW.EPA.GOV/METHANE.